WS72324

Low-Power Rail-to-Rail Input Output Operational Amplifiers

Http://www.omnivision-group.com

Descriptions

The WS72324 series is a quad low-voltage operational amplifier with rail-to-rail input/output swing. Ultra low quiescent current makes this amplifier ideal for portable, battery operated equipment. The common mode input range includes ground making the device useful for low−side current−shunt measurements.

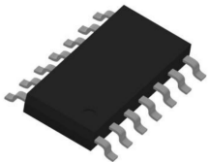
The WS72324 is available with MSL 3 Level in SOP-14L, TSSOP-14L and QFN3x3-16L package. Standard products are Pb-Free and halogen-Free.

Applications

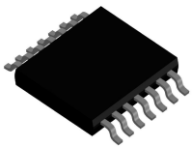
- Active Filters
- Smoke/Gas Sensors
- Battery Powered Electronic Equipments
- Personal Medical Care

Features

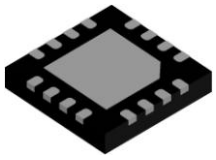
- Single Supply Voltage : 1.8~5.5V
- Quiescent Current : 42μA Typical
- GBWP : 1.5MHz
- Slew Rate : 1.1V/μs
- Offset Voltage : 3mV Maximum
- Offset Voltage Temp. Drift : 1μV / ℃
- THD+N :-102dB@1kHz, -90dB@10kHz
- CMRR/PSRR : 101dB/105dB
- Output Short-Circuit Curr. : 43mA
- -40℃ to 125℃ Operation Range
- Drives 2kΩ Resistive Loads
- No Output Crossover Distortion
- No Phase Reversal from Overdriven Input
- Rail-to-Rail Input/Output Swing



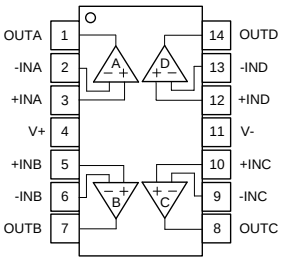
SOP-14L

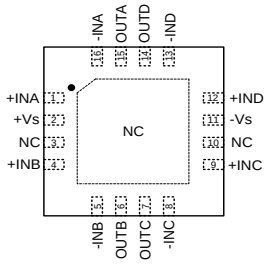


TSSOP-14L



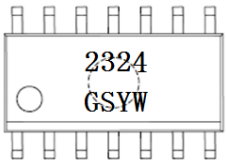
QFN3x3-16L

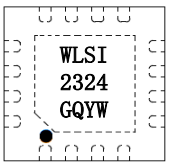




SOP-14L/TSSOP-14L QFN3x3-16L

Pin configuration (Top view)





SOP-14L TSSOP-14L QFN3x3-16L

Marking

2324 = Device code
GS = Special code
GH = Special code
GQ = Special code
Y = Year code
W = Week code

Order Information

Device	Package	Shipping
WS72324S-14/TR	SOP-14L	4000/Reel &Tape
WS72324H-14/TR	TSSOP-14L	4000/Reel &Tape
WS72324Q-16/TR	QFN3x3-16L	3000/Reel &Tape

Pin Descriptions (WS72324S-14/TR & WS72324H-14/TR)

Pin Number	Symbol	Descriptions
1	OUTA	Output of Amplifier A
2	-INA	Inverting input of Amplifier A
3	+INA	Non-inverting input of Amplifier A
4	V+	Positive supply
5	+INB	Non-inverting input of Amplifier B
6	-INB	Inverting input of Amplifier B
7	OUTB	Output of Amplifier B
8	OUTC	Output of Amplifier C
9	-INC	Inverting input of Amplifier C
10	+INC	Non-inverting input of Amplifier C
11	V-	Negative supply
12	+IND	Non-inverting input of Amplifier D
13	-IND	Inverting input of Amplifier D
14	OUTD	Output of Amplifier D

Pin Descriptions (WS72324Q-16/TR)

Pin Number	Symbol	Descriptions
1	+INA	Non-inverting input of Amplifier A
2	V+	Positive supply
3, 10	NC	No connect
4	+INB	Non-inverting input of Amplifier B
5	-INB	Inverting input of Amplifier B
6	OUTB	Output of Amplifier B
7	OUTC	Output of Amplifier C
8	-INC	Inverting input of Amplifier C
9	+INC	Non-inverting input of Amplifier C
11	V-	Negative supply
12	+IND	Non-inverting input of Amplifier D
13	-IND	Inverting input of Amplifier D
14	OUTD	Output of Amplifier D

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply Voltage, ([V+] – [V-])	V_S (2)	6	V
Input Differential Voltage	V_{IDR} (3)	±6	V
Input Common Mode Voltage Range	V_{ICR}	(V^-)-0.2 to (V^+)+0.2	V
Output Short-Circuit Duration	t_{SO}	Unlimited	/
Operating Fee-Air Temperature Range	T_A	-40 to 125	°C
Storage Temperature Range	T_{STG}	-65 to 150	°C
Junction Temperature Range	T_J	150	°C
Lead Temperature Range	T_L	260	°C

Note:

1. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are only stress ratings, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions are not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2. All voltage values, except differential voltage are with respect to network terminal.
3. Differential voltages are at +IN with respect to -IN.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum level	Unit
HBM	Human Body Model ESD	MIL-STD-883H Method 3015.8 JEDEC-EIA/JESD22-A114A	±8000	V
MM	Machine Model ESD	JEDEC-EIA/JESD22-A115	±400	V
CDM	Charged Device Model ESD	JEDEC-EIA/JESD22-C101E	±2000	V

Electronics Characteristics

The ***** denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25℃. V_S = 5V, V_{CM} = V_{OUT} = V_S/2, R_{load} = 100kΩ, C_{load} =100pF

Symbol	Parameter		Conditions		Min.	Typ.	Max.	Unit
V_{OS}	Input Offset Voltage		V_{CM}= V_S/2	*	-3.0	±0.1	3.0	mV
α_{VOS}	Input Offset Voltage Drift					1		μV/℃
I_{IB}	Input Bias Current					1		pA
I_{OS}	Input Offset Current					1		pA
V_n	Input Voltage Noise		f=0.1Hz to10Hz			4.5		μV_{P-P}
e_n	Input Voltage Noise Density		f=1kHz			30		nV/√Hz
			f=10kHz			23		
CMRR	Common Mode Rejection Ratio		V_{CM}=0.1V to 4.9V	*	70	101		dB
V_{CM}	Common Mode Input Voltage Range			*	(V^-)-0.2		(V^+)+0.2	V
PSRR	Power Supply Rejection Ratio			*	85	105		dB
A_{VOL}	Open Loop Large Signal Gain		V_{OUT}=0.1V to 4.9V, R_{load}=10kΩ	*	100	109		dB
V_{OH}	High Level Output Voltage		R_{load}=2kΩ			50		mV
			R_{load}=10kΩ			5		
V_{OL}	Low Level Output Voltage		R_{load}=2kΩ			40		mV
			R_{load}=10kΩ			5		
I_{SC}	Output Short-Circuit Current		Source Current			43		mA
			Sink Current			47		
I_Q	Quiescent Current per Amplifier			*		42	62.5	μA
PM	Phase Margin		R_{load}=100kΩ, C_{load}=100pF			60		degrees
GM	Gain Margin		R_{load}=100kΩ, C_{load}=100pF			-14		dB
GBWP	Gain-Bandwidth Product		f=1kHz			1.5		MHz
t_S	Settling Time	1.5 to 3.5V, Unity Gain	0.1%			1.9		μs
		2.45 to 2.55V, Unity Gain	0.1%			0.29		
SR	Slew Rate		A_V=1, V_{OUT}=1.5V to 3.5V, R_{load}=100kΩ, C_{load}=100pF			1.1		V/μs
FPBW	Full Power Bandwidth		$2V_{P-P}$			180		kHz
THD+N	Total Harmonic Distortion and Noise		f=1kHz, AV=1, R_{load}=100kΩ, V_{OUT}=$2V_{PP}$			-102		dB
			f=10kHz, AV=1, R_{load}=100kΩ, V_{OUT}=$2V_{PP}$			-90		

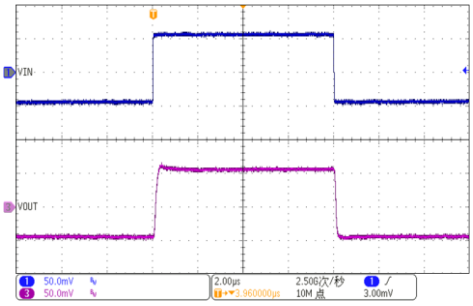
Note:

1. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.
2. A heat sink may be required to keep the junction temperature below the absolute maximum rating when the output is shorted indefinitely.
3. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.
4. Full power bandwidth is calculated from the slew rate FPBW = SR/(π • V_{P-P}).

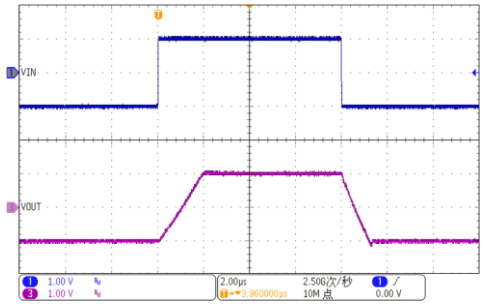
Typical Characteristics

T_A=25℃, V_S=±2.5V, V_{CM}=0V, unless otherwise noted

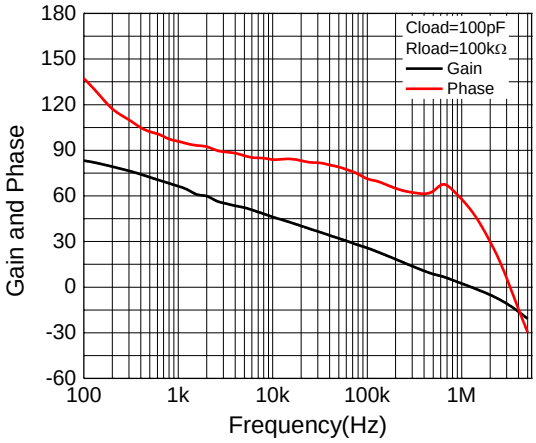
Small-Siganl Step Response, 100mV Step



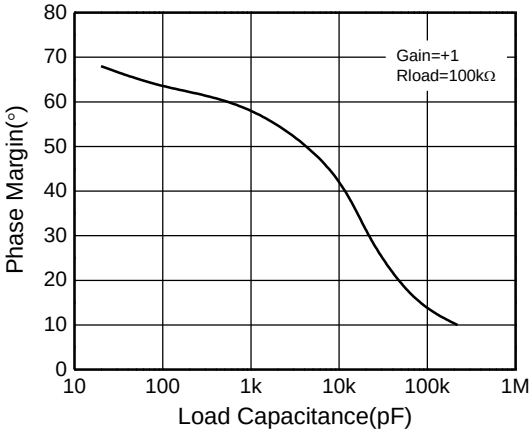
Large-Siganl Step Response, 2V Step



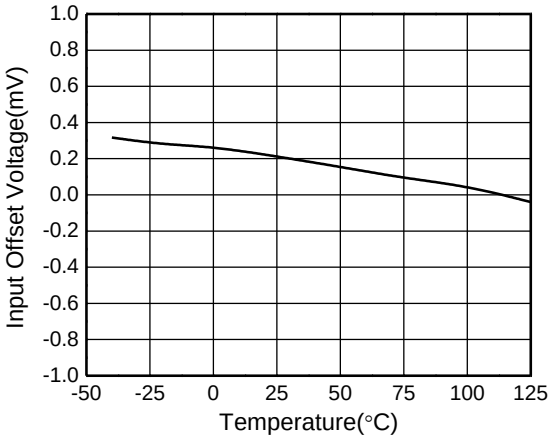
Open-Loop Gain and Phase



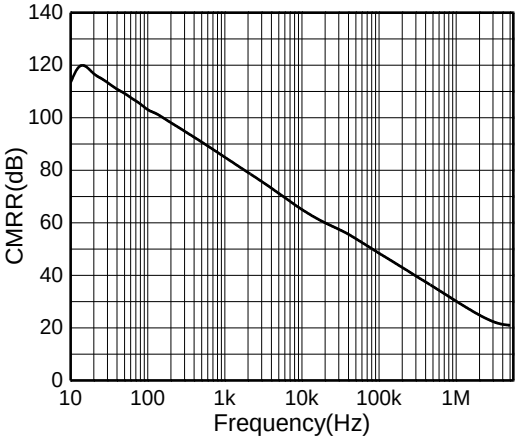
Phase Margin vs. C_{load}(Stable for Any C_{load})



Input Offset Voltage vs. Temperature



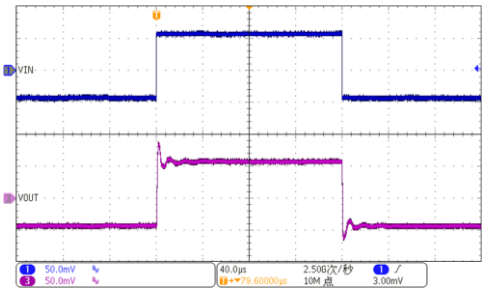
CMRR vs. Frequency



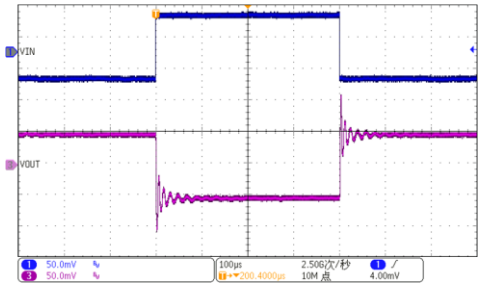
Typical Characteristics (continued)

T_A=25℃, V_S=±2.5V, V_{CM}=0V, unless otherwise noted

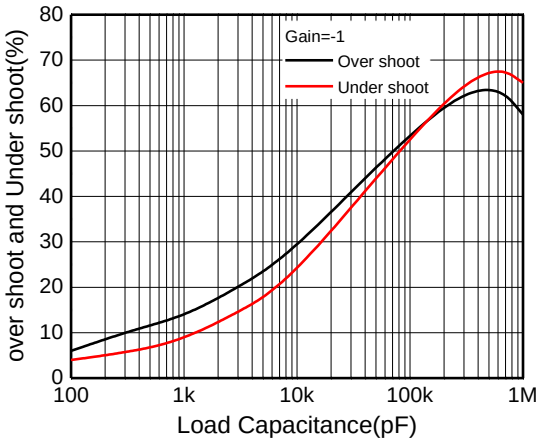
Over Shoot Voltage, C_{load}=47nF, R_{FB}=10kΩ, Gain=+1



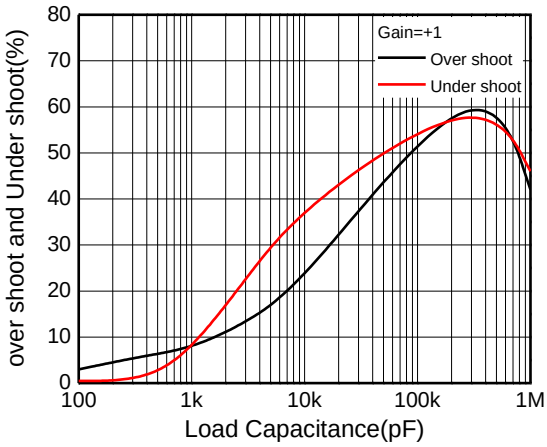
Over Shoot Voltage, C_{load}=47nF, R_{load}=40kΩ, Gain=-1



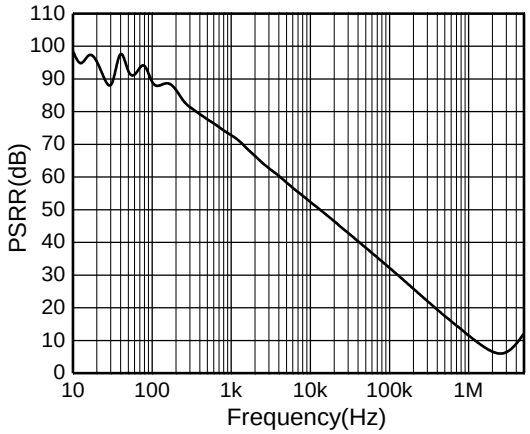
Over-Shoot % vs. C_{load} Gain=-1, R_{FB}=20kΩ



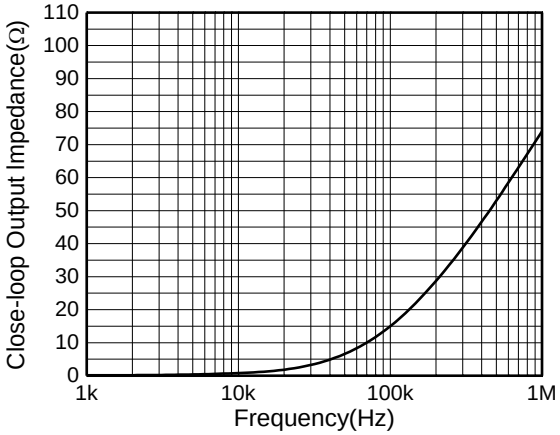
Over-Shoot % vs. C_{load} Gain=+1



PSRR vs. Frequency



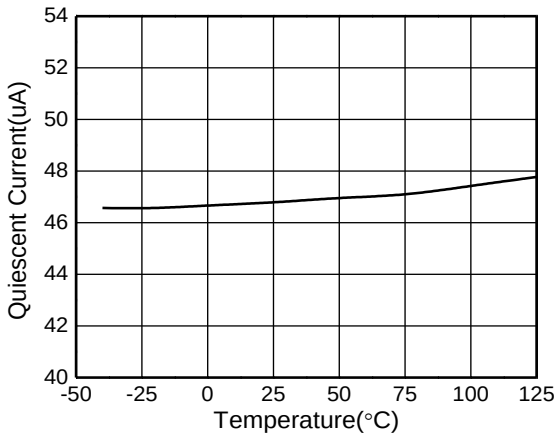
Closed-Loop Output Impedance vs. Frequency



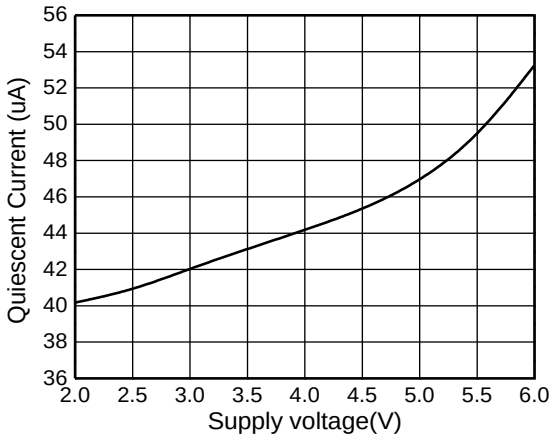
Typical Characteristics (continued)

T_A=25℃, V_S=±2.5V, V_{CM}=0V, unless otherwise noted

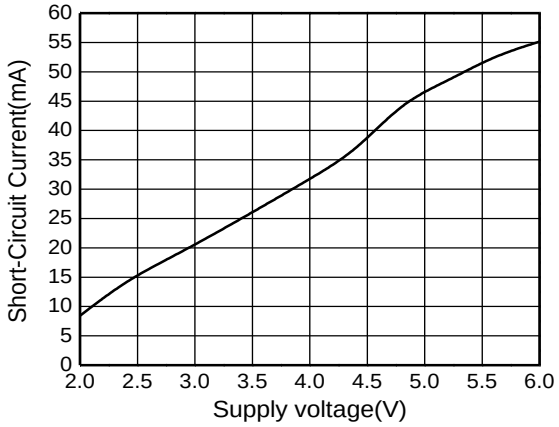
Quiescent Supply Current vs. Temperature



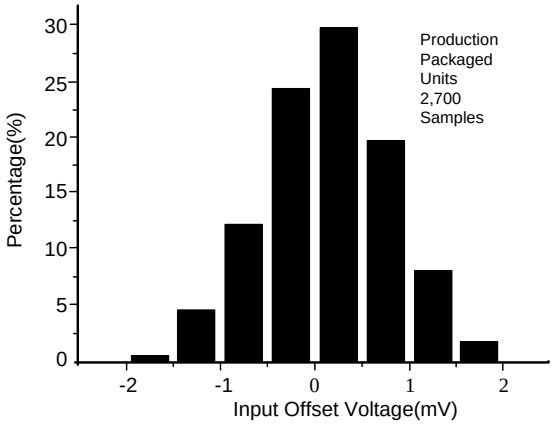
Quiescent Supply Current vs. Supply Voltage



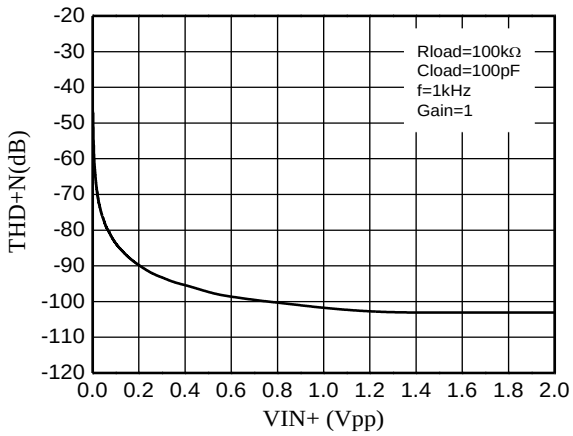
Short-Circuit Current vs. Supply Voltage



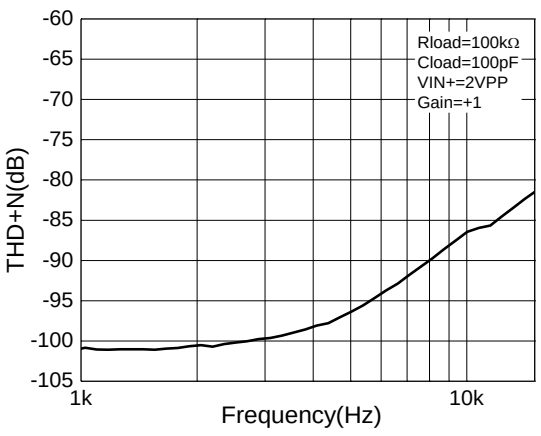
Input Offset Voltage Distribution



THD+Noise vs. Vin+



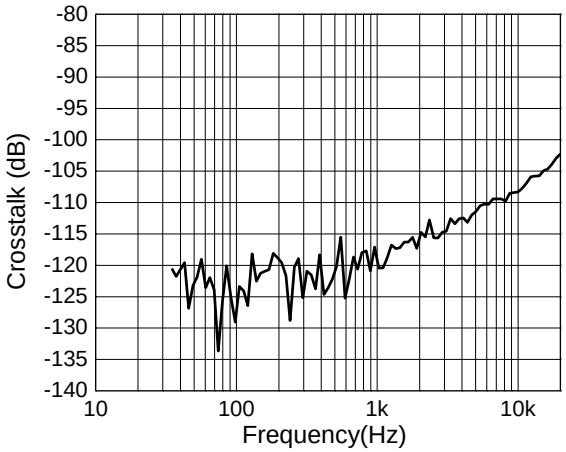
THD+Noise vs. Frequency



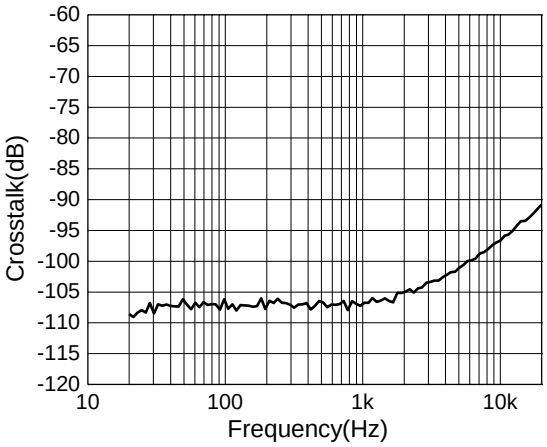
Typical Characteristics (continued)

T_A=25℃, V_S=±2.5V, V_{CM}=0V, unless otherwise noted

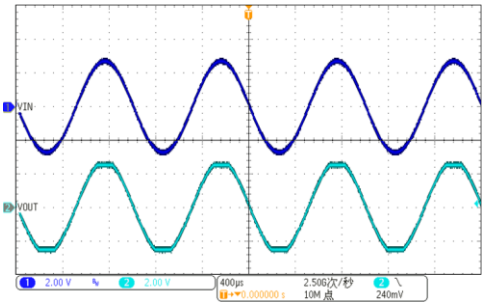
Crosstalk, A-Channel to B-Channel



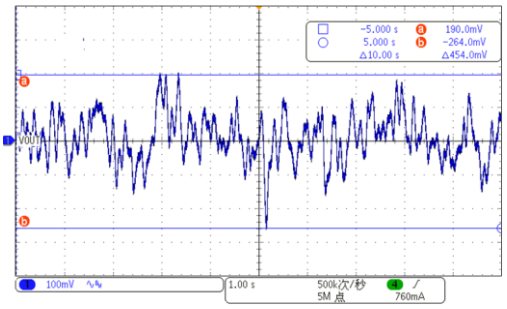
Crosstalk, A-Channel to C-Channel



VIN=-0.2V to 5.7V, No Phase Reversal

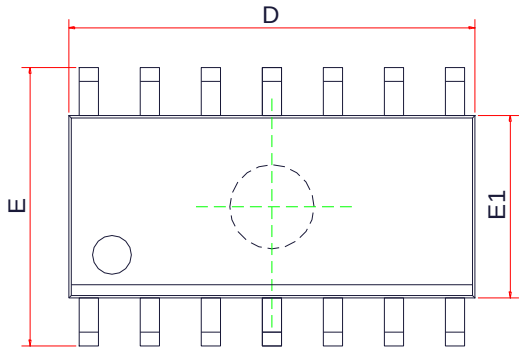


0.1Hz to 10Hz Integrated Input Noise, Gain = 100000

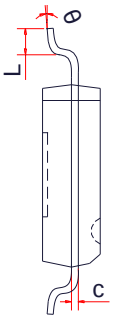


PACKAGE OUTLINE DIMENSIONS

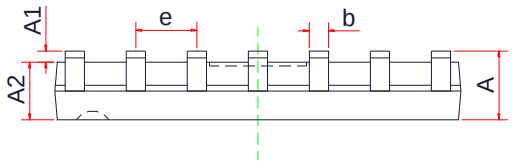
SOP-14L



TOP VIEW



SIDE VIEW



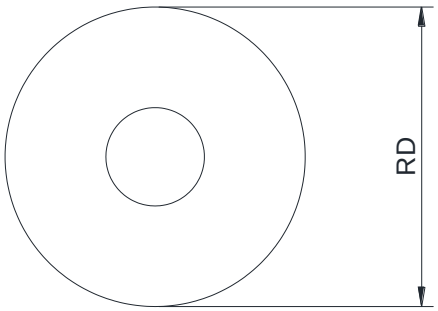
SIDE VIEW

Symbol	Dimensions In Millimeters (mm)		
	Min.	Typ.	Max.
A	-	-	1.75
A1	0.10	-	0.25
A2	1.25	-	-
b	0.31	0.41	0.51
c	0.10	-	0.25
D	8.45	8.65	8.85
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.40	-	1.27
θ	0°	-	8°

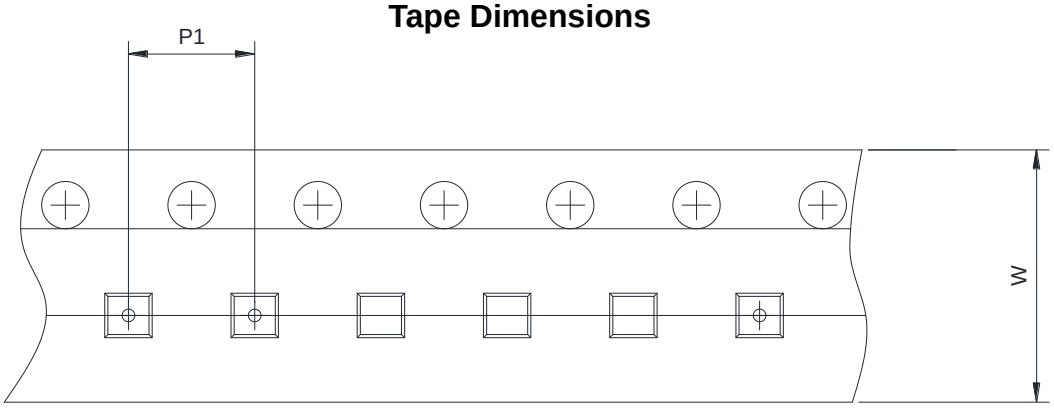
TAPE AND REEL INFORMATION

SOP-14L

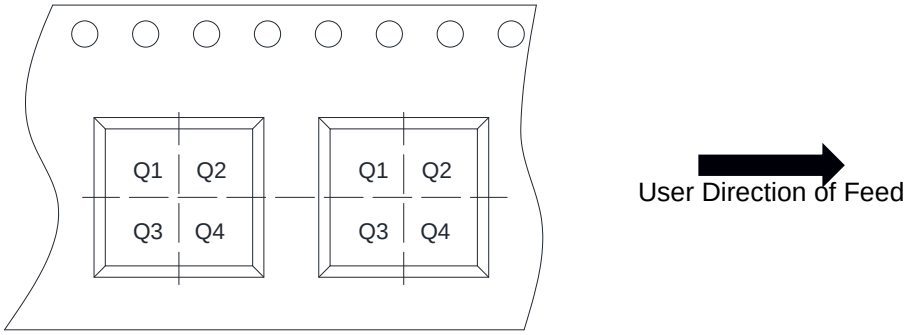
Reel Dimensions



Tape Dimensions



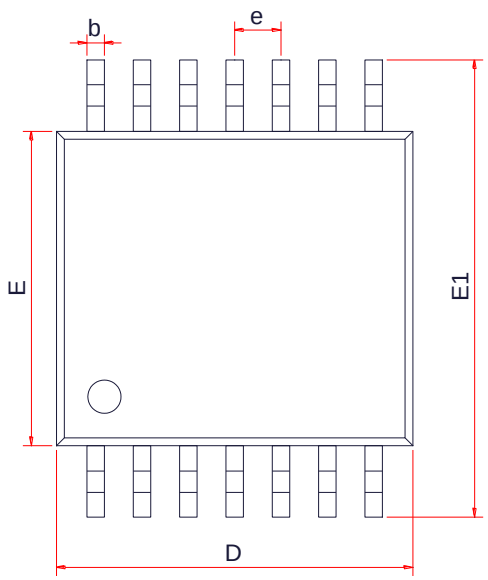
Quadrant Assignments For PIN1 Orientation In Tape



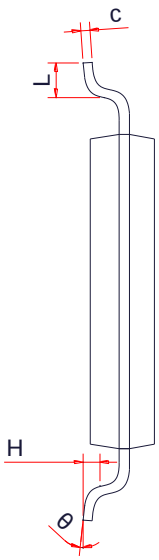
RD	Reel Dimension	☐ 7inch ☑ 13inch
W	Overall width of the carrier tape	☐ 8mm ☐ 12mm ☑ 16mm
P1	Pitch between successive cavity centers	☐ 2mm ☐ 4mm ☑ 8mm
Pin1	Pin1 Quadrant	☑ Q1 ☐ Q2 ☐ Q3 ☐ Q4

PACKAGE OUTLINE DIMENSIONS

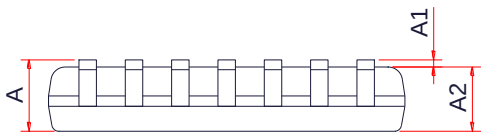
TSSOP-14L



TOP VIEW



SIDE VIEW



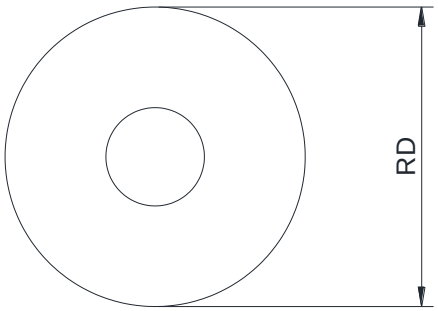
SIDE VIEW

Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	-	-	1.20
A1	0.05	-	0.15
A2	0.80	0.90	1.00
b	0.19	-	0.30
c	0.09	-	0.20
D	4.90	5.00	5.10
E	4.30	4.40	4.50
E1	6.25	6.40	6.55
e	0.65 BSC		
L	0.50	0.60	0.70
H	0.25Typ		
θ	1 °	-	7 °

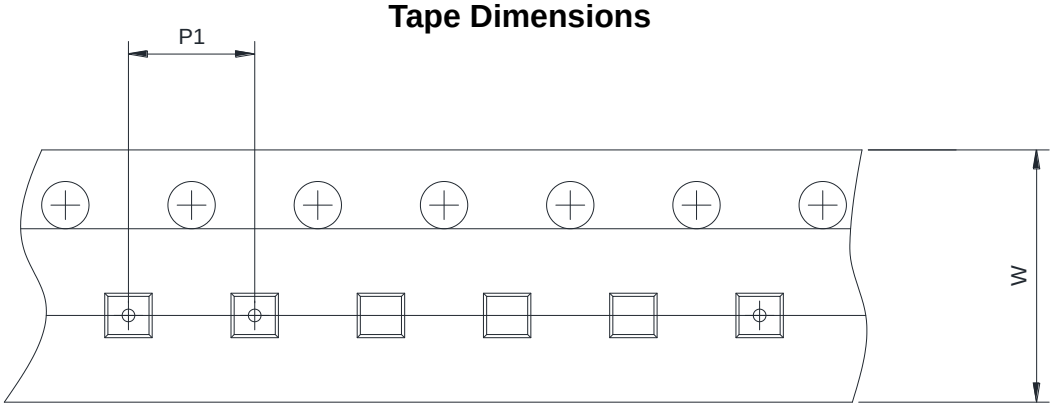
TAPE AND REEL INFORMATION

TSSOP-14L

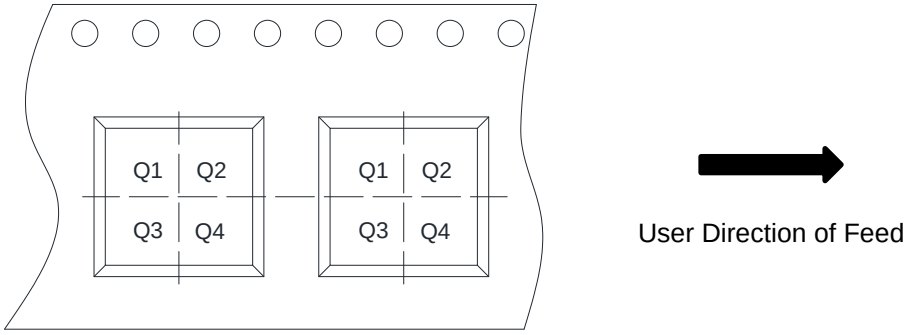
Reel Dimensions



Tape Dimensions



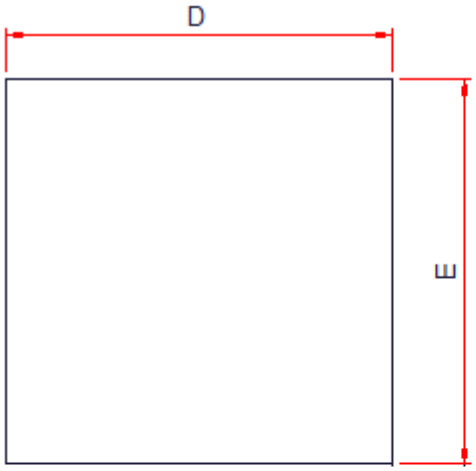
Quadrant Assignments For PIN1 Orientation In Tape



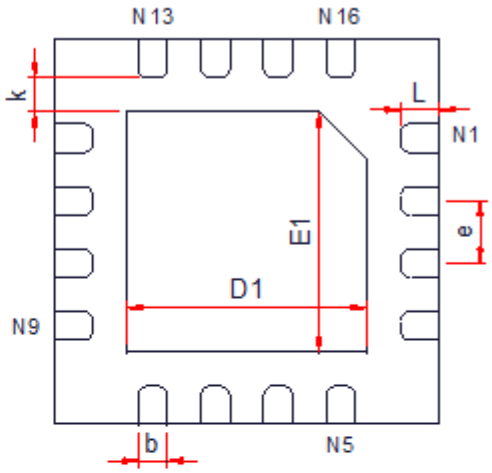
RD	Reel Dimension	☐ 7inch	☑ 13inch		
W	Overall width of the carrier tape	☐ 8mm	☑ 12mm	☐ 16mm	
P1	Pitch between successive cavity centers	☐ 2mm	☐ 4mm	☑ 8mm	
Pin1	Pin1 Quadrant	☑ Q1	☐ Q2	☐ Q3	☐ Q4

PACKAGE OUTLINE DIMENSIONS

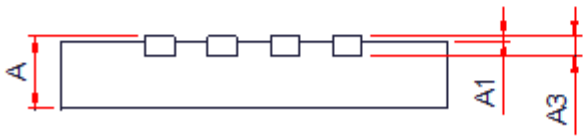
QFN3x3-16L



TOP VIEW



BOTTOM VIEW



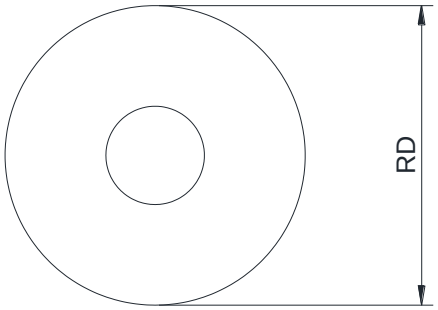
SIDE VIEW

Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3		0.203 REF	
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D1	1.60	1.70	1.80
E1	1.60	1.70	1.80
k	0.30	0.35	0.40
b	0.20	0.25	0.30
e		0.50 BSC	
L	0.25	0.30	0.35

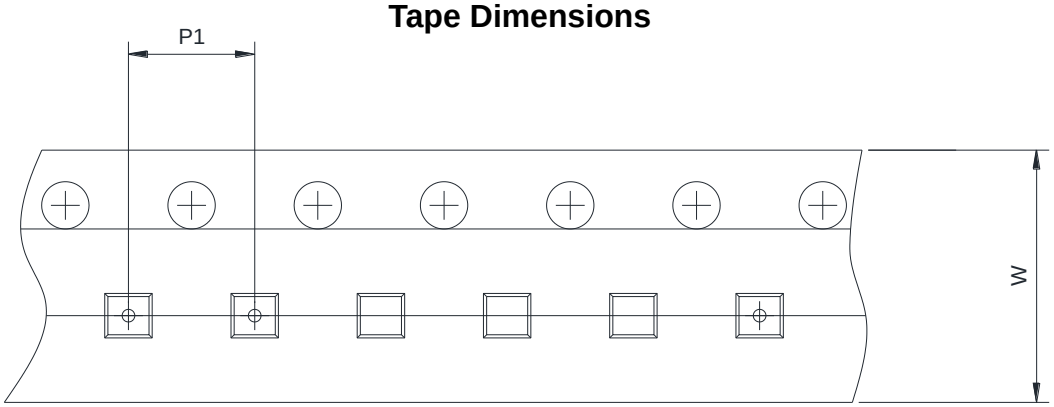
TAPE AND REEL INFORMATION

QFN3x3-16L

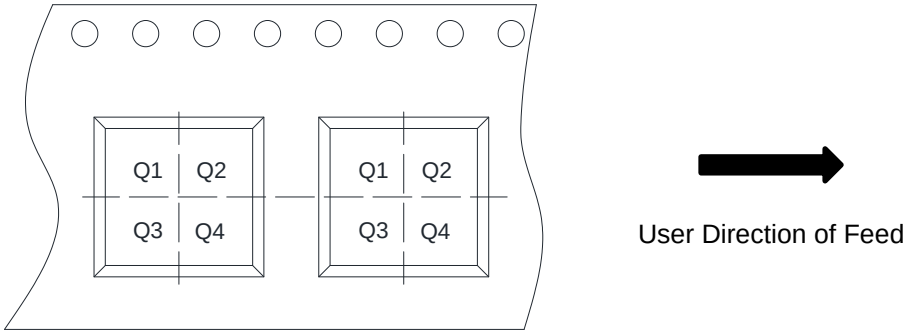
Reel Dimensions



Tape Dimensions



Quadrant Assignments For PIN1 Orientation In Tape



RD	Reel Dimension	☐ 7inch ☑ 13inch
W	Overall width of the carrier tape	☐ 8mm ☑ 12mm ☐ 16mm
P1	Pitch between successive cavity centers	☐ 2mm ☐ 4mm ☑ 8mm
Pin1	Pin1 Quadrant	☐ Q1 ☑ Q2 ☐ Q3 ☐ Q4